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Talking to 35kV Transmission Line Project Design

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Abstract

With the continuous improvement of the main grid structure of my country's power grids. In recent years, the investment in the construction of 35kV and below distribution networks has been increasing. This article focuses on the feasibility study report of 35kV and below transmission lines and the design ideas encountered in the preliminary design, Problems and their precautions for analysis. Only by clarifying the design focus and optimizing the design ideas can the stable operation of the transmission lines of the distribution network be guaranteed.

Keywords

35kV Transmission Line Design; Feasibility Study; Initial Design.

1. Introduction

With the continuous improvement of the main grid structure of my country's power grid. In recent years, the investment in the construction of 35kV and below distribution networks has been increasing. This article analyzes the design ideas, problems and precautions encountered in the feasibility study report and preliminary design of 35kV and below transmission lines. Only by clarifying the design focus and optimizing the design ideas can the stable operation of the transmission lines of the distribution network be guaranteed.

2. Feasibility Study Report Design

2.1 Engineering Feasibility Study

Before drawing up a construction project, analyze the benefits of the project in terms of nature, society, economy, technology, etc., and determine the feasibility of the project based on the construction necessity of the project, the design plan, and the evaluation of the economic benefits after the project is completed. Feasibility study occupies an important position in project investment and construction.

2.2 The Necessity of Engineering Construction

35kV and below transmission lines are closely connected with industry, farming and people's lives. Before planning to build a new line, it is necessary to conduct a detailed investigation of the geographic location, floor space, arable land area, industrial quantity, permanent population, urbanization rate, annual gross product (GDP) and per capita GDP of the region to collect funds. According to the current status map of the local power grid, count the number of existing substations, the capacity of transformers and their distribution locations, and with the cooperation of relevant power departments, count the main transformer models, maximum loads and operating conditions of the lines and their conductor types in each substation. And compared with the electricity consumption of agriculture, industry and residents in the area in the past 5 years. To determine whether to meet the

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"N-1" demand of the power grid, it should also cooperate with the development plan of the local government, the type of power supply area and the power supply radius, and carry out reasonable capacity expansion and distribution. For lines to be renovated, check whether the concrete poles and fork beams have cracks and exposed ribs, whether the insulation configuration meets the current pollution level requirements, the degree of aging and corrosion of the fittings, the elasticity of the steel strands, the grounding resistance value and the ground distance of the conductors meet the specifications Requirements, and whether the wire diameter of the wire can meet the current needs. Consider from the aspects of satisfying load development, safe operation, improving power supply reliability, and ensuring social benefits.

2.3 Transmission line design

2.3.1 Selection of Transmission Line Route

The path selection of overhead transmission lines is the soul of the entire project design. Whether it is reasonable or not directly affects the project cost and social benefits of the line. In the process of selecting the route, the route of the route must meet the urban planning to reduce the impact on the existing or proposed buildings. Make full use of the existing corridors and reserve corridors for the subsequent outgoing lines of the substation. Try to bypass the village as much as possible to reduce the demolition of houses. Try to avoid cultural relic protection areas, natural scenic areas, forest areas and military management areas, flammable and explosive materials, and goafs. Avoid large corners, reduce path plans with small corners, and seek the best aviation distance.

In the past, the route selection was performed on a map with a ratio of 1:5000 or 1:50000. The error was large and the update speed of the map was slow. With the change of the times, some open areas have become rural areas, which affects the site survey. Work efficiency [1]. With the development of satellite technology in China, real-time satellite images are provided. In the satellite images, you can even see railways, highways, and power lines that have been crossed, which facilitates route selection. Mark the positions of the substations at both ends on the map, select 2 to 3 feasible path plans based on satellite images, and record the coordinates of each corner. Adhering to: small aviation distance, reduction of unnecessary crossovers, convenient construction of poles and towers, and economic efficiency, the optimal plan is selected.

2.3.2 Technical Requirements for Line Corners

(1) In mountainous areas, avoid setting corners in areas where there are no slopes, landslides and collapses. When passing through the foothills, consider the location of the drainage ditch. As far as possible, choose the position that is easy to reach by the construction tool as the corner position [2].

(2) In river beach areas, avoid setting corners in riverbeds, tributaries, flood drainage channels, and scouring areas. When crossing the river, it is generally designed as an isolated gear as much as possible. When there is a big leap, the horizontal span of the isolated gear cannot meet the requirements, and the tower needs to be erected in the water with the technical assistance of the local water conservancy department to seek a location with high river bed stability. And collect hydrological data in the past 50 years to facilitate the design of the tower foundation during the preliminary design [3].

2.3.3 Wire Selection

In the construction of transmission lines, wire investment accounts for about 20% of the investment in the main body of the line. Therefore, the rationality of wire selection is of great significance for optimizing the investment of transmission lines. According to the maximum transmission capacity and the normal transmission capacity of the proposed line, the current capacity is calculated. In recent years, in addition to the steel core aluminum stranded wire, various new materials of conductors have appeared. Combining the current carrying capacity under different working conditions, compare the conductors The weight, wire consumption, wire cost, tower load, wire sag and overload capacity can be selected to select the best type and material of wire.

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2.3.4 Crossings

Important crossings of overhead transmission lines, such as crossing railways, high-speed, important communication lines, and crossing high-voltage lines, need to go to relevant units in the feasibility study stage to obtain path agreements.

In the feasibility study stage, the continuous optimization of the route design and wire selection can not only reduce the project cost.

3. Initial Design

3.1 Line Exploration

Different from the survey during the feasibility study period, in the preliminary design stage, design and surveying personnel are required to conduct on-site surveys, conduct on-site surveys on all paths of the route, and record in detail the topography and crossovers of the route, when the route is connected with surrounding houses, pipelines, etc. When important facilities cross or pass in parallel, relevant location data shall be measured. In order to facilitate the verification when the designer carries out the pole design on the plane section.

3.2 Meteorology Condition

Meteorological conditions have a great influence on the design of transmission lines. You should go to the local meteorological bureau to learn about the high temperature, low temperature, wind speed, rainfall, snowfall, and geological disasters in the area. It is convenient to verify the force of the conductor and the tower under various working conditions in the design of the plane section [4]:

(1) Maximum temperature: At this time, when the wire is at the maximum sag, ensure a safe distance to the ground and the building.

(2) The average temperature of the highest temperature month (the monthly average of the highest daily temperature of the hottest month, take the multi-year average): to ensure the current carrying capacity of the wire.

(3) Minimum temperature: to ensure the maximum stress of the wire, and to check the pull-up of the overhanging series conductor ground wire.

(4) Maximum wind speed: Calculate the influence of external forces on poles, towers, fittings, etc., and check whether the safety distance between the wire and the nearby building or slope meets the requirements.

(5) Thickness of ice: Calculate the mechanical strength of the poles and wires.

(6) Annual thunderstorm day: Check the lightning protection of the tower.

The maximum temperature, minimum temperature, wind speed and icing shall be taken as the basic conditions of meteorology when designing the route. It is not only necessary to consider the rationality of the design in terms of economy and technology. And in the case of disconnection in low temperature, strong wind and icing conditions, ensure that the tower does not fall. At the same time, we must also consider the convenience of construction, operation and maintenance of the line under different working conditions to ensure the safety of the staff.

3.3 Insulation Coordination

3.3.1 Classification of Pollution Levels

The level is determined according to the pollution degree of the area where the substation is located or the area where the overhead transmission line passes. The natural pollution level on the surface of the insulator is divided into two categories, A and B. When the surface contains insoluble solids and conducts electricity when damp, it is called Class A, which can be measured by equivalent salt density and ash density. When there is a liquid electrolyte on the surface and a small amount of insoluble matter is called type B, it can be measured by the equivalent conductivity of the liquid solution and the ash density [5].

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Considering standardization, the natural pollution levels on the surface of insulators can also be divided into A, B, C, D, and E levels (very light, light, medium, heavy, and very heavy). The path through the line is combined with the pollution distribution map. Determine the uniform creepage distance. The uniform creepage distance is equal to the ratio of the creepage distance of the insulator to the highest operating voltage that both ends bear.

3.3.2 Choice of Insulator

In severely polluted areas, in order to avoid pollution flashover of insulator strings and improve the stable operation of the line, the choice of insulators is very important. In heavy and very polluted areas, pollution-resistant insulators can be used to increase creepage by adding umbrella skirts. distance. Composite insulators can also be used.

For new transmission lines, ordinary porcelain, glass or composite insulators can be used in lightly polluted areas; V-type or inverted V-type string anti-pollution insulators or composite insulators can be used in medium-polluted areas; I-type, V-type or inverted V-type composite insulators It can be used in heavily polluted areas and very heavily polluted areas.

3.4 Lightning Protection Grounding and Communication

3.4.1 Lightning Protection and Communication

The protection angle of the ground wire and the coordination of the ground wire, the distance S between the center wire of the pitch and the ground wire is satisfied (L is the pitch) [5]:

$$s \geq 0.012L + 1$$

The number of ground wires should be judged according to the distribution map of the area minefields. Generally, the protection angle should be less than 20°[4]. For 35 kV lines, lightning protection lines are generally not erected across the entire line, but only 1 to 2 km from the substation's incoming and outgoing lines. But this is not absolute. If the thunderstorm day exceeds 40 days, the ground wire should be extended to 3km or longer; if the line is short, in order to protect the equipment in the substation stations at both ends, the ground wire must be erected on the whole line. But with the advancement of science and technology, nowadays, the ground wire (stranded wire) and the communication wire (ADSS optical cable) are combined into one, using Optical Fiber Composite Overhead Ground Wire, referred to as OPGW. The load on the iron tower is very small, and the engineering cost of the transmission line is also reduced.

3.4.2 Grounding

The 35kV full-line poles and towers should be grounded base by base. According to the different terrain and soil resistivity, iron towers generally use large square ring plus radiation grounding devices, steel poles generally use double grounding devices, because the 35kV overhead ground wire is cut off outside the substation station, if the substation lightning rod cannot protect the terminal of the incoming station Tower, you need to install lightning rods on the terminal tower, and increase the number of insulators on the large side of the line terminal tower by one voltage level.

3.5 Tower and Foundation

3.5.1 Tower Design

With the continuous advancement of technology, the selection of transmission line towers ranges from old-fashioned concrete pole erection to tower catalogues, and then to the 35kV universal design of "General Design for Transmission and Transformation Engineering of State Grid Corporation" published by State Grid Corporation, Adding a touch of color to the future 35kV transmission line design. According to the meteorological conditions in the area, the design requirements of single/double circuit and the wire type, the design module of the required tower can be selected. In the design of the tower with flat section, the horizontal span and the vertical span that the pole and tower in the module can withstand should be met [6].

The connection bolts and rods of the line tower are stolen, which has become a serious phenomenon causing tower collapse accidents, and it is also a common social problem that directly endangers the

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normal and safe operation of the line. Generally, in the project, the connecting bolts within 8 meters above the ground adopt anti-theft bolts, and the other bolts adopt anti-loosening measures.

3.5.2 Tower foundation design

In the design of the iron tower foundation, it must be determined according to factors such as the geological type, hydrology, soil density, allowable endurance, groundwater depth, and maximum frozen soil depth along the line. The general foundation forms include steps, digging and pouring foundations. The bench foundation has wide applicability and is easy to construct when the groundwater level is low. However, the large amount of earthwork excavates, which leads to the increase of project cost such as young crop compensation and the destruction of ecological vegetation; on the one hand, the excavation of the excavation foundation is smaller. On the other hand, it saves the project cost and construction period, but the excavation foundation is suitable for cohesive soil without groundwater; the construction cost of the cast-in-place pile foundation is high, and it is generally used in places where the foundation is subject to greater force under the influence of topography [7].

4. Conclusion

To sum up, the feasibility study stage requires a large amount of theoretical demonstrations to demonstrate the necessity of construction and the feasibility of the route planning scheme, and to prepare a budget. After establishing a stable basic framework, preliminary design is carried out, and the appropriate location is selected through on-site surveys. In order to build a strong smart grid and ensure the quality of people's power consumption, feasible research and design and preliminary design are particularly important.

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